Annual Report: Determining interannual variability in vegetation structure and the relationship between structure and ecosystem function at Wild Basin Wilderness Preserve

Date: 28 October, 2014

Investigators

David R. Johnson, PhD
Visiting Assistant Professor
St. Edward's University
3001 S. Congress
Austin, TX 78704
915-258-1111
davidjo@stedwards.edu

Alyseia Alexander
Undergraduate Research Assistant
St. Edward's University

Daniel Ben-Moyel
Undergraduate Research Assistant
St. Edward's University

Dominic Bruno
Undergraduate Research Assistant
St. Edward's University

Elizabeth Nowaicek
Undergraduate Research Assistant
St. Edward's University

ABSTRACT – Resampling fixed plots and/or transects within plant communities represents one of the strongest methods of change detection of ecosystem structure and function. With this in mind, the primary goal of our project was to resample plots and transects within Wild Basin that were originally sampled in 2013 to determine how the vegetation structure at Wild Basin differed between 2013 and 2014. Additionally, we sought to understand how structure dictates function by estimating leaf decomposition. Although we had planned to measure leaf level photosynthesis of the dominant plant species and extrapolate estimates over cover values for species across the different communities identified by the original sampling in 2013, we were not able to do so due to equipment issues. To estimate decomposition, we collected senesced but attached leaf litter from the dominant tree species (Red Oak: *Quercus texana,* Evergreen sumac: *Rhus virens*, and Ashe juniper: *Juniperus ashei*) and place these in litterbags. After two weeks, litter bags were removed from the field and we determined biomass loss and fungal colonization rates among communities. The analysis of community composition is not complete, however our initial work with these data found no differences in growth forms among the various communities between 2013 and 2014. Additionally, we found that leaf decomposition varied differently than we had predicted. Evergreen sumac decomposed the fasted, while Ashe juniper

decomposed the slowest. This study provides a better understanding of the interannual variability in vegetation structure as well as how structure dictates ecosystem function at Wild Basin.

INTRODUCTION

Resampling fixed plots and/or transects within plant communities represents one of the strongest methods of change detection of ecosystem structure and function (e.g. Callaghan et al. 2011). While informal qualitative understanding of the vegetation structure has existed for the Wild Basin for some time (Williams 1977, Respes 1987), a formal quantitative assessment of the vegetation structure took place in 2013 (Johnson 2013). Within Wild Basin, five distinct vegetation communities were identified. The dominant drivers of vegetation structure were identified as percent canopy cover as well as soil sand content (Johnson unpublished data). Specifically the Edwards Plateau, and Central Texas more generally, often experiences high interannual variability in both temperature and precipitation. Because native plant species have evolved within the landscape experiencing this variability, they have hypothetically adapted to respond phenologically to this interannual variation. Thus, vegetation structure may differ year to year within Wild Basin and similar landscapes.

Our primary goal was to determine the interannual variation in vegetation structure of Wild Basin as well as to determine how structure dictates ecosystem function. To estimate the interannual variability in plant community structure, we resampled transects and plots originally surveyed in 2013 for plant community composition in Wild Basin Preserve in the early summer 2014. These plots and transects are near photo-points located throughout the preserve (Figure 1). Additionally, although we had planned to estimate ecosystem function by measuring leaf-level photosynthesis for the dominant plant species using a LiCor 6400, we were unable to do so due to issues with this equipment. However, we collected senesced but attached plant leaves from dominant three species (*Quercus texana. Rhus virens*, and *Juniperus ashei*) using plants along the trail system. For this project, we asked:

i. Does plant community composition differ between 2013 and 20114?
ii. Do evergreen species decompose more slowly than deciduous species, as one might predict based on the complexity of leaf carbon?

This study provides a better understanding of how vegetation structure varies year to year, as well as to provide an estimate of how vegetation structure controls ecosystem function, namely carbon loss due to respiration via plant leaf chemistry.

METHODS

We resampled three transects and nine plots at each photo point (Figure 1). Each transect consists of one 30 m transect to determine tree canopy structure. Three plots are located at the 9, 18, and 27 meter marks along the transect. Plots consist of 50 x 50 cm quadrats and are used to determine understory vegetation. We recorded the species composition of tree canopy species using a line intercept method and ground cover/understory vegetation using a point-frame method (Inouye 2002). Data were entered into a relational database for analysis. Species cover and abundance data were

summarized to growth form for preliminary analysis presented here and M ANOVA was performed to detect differences between the growth forms in 2013 and 2014 among the various plant communities.

We collected senesced but attached leaves from the three dominant tree species (Red Oak: *Quercus texana,* Evergreen sumac: *Rhus virens*, and Ashe juniper: *Juniperus ashei*). These were returned to St. Edward's campus, weighed and placed in litter bags constructed of standard shade cloth. Litterbags (approximately 10 cm x 10 cm) were returned and buried within the leaf litter near the plots described above in each plant community. After two weeks, litter bags were removed from the field and returned to St. Edward's campus and weighed for final mass. Decomposition rate was calculated by taking the natural log of the final mass divided by the initial mass of each leaf.

PRELIMINARY RESULTS

We found no statistically significant differences in plant growth forms between 2013 and 2014 (Figure 2). Though small differences were evident, none were found to be statistically different. Thus, communities seem to be structure the same in 2013 as 2014 with respect to growth forms. A more in depth analysis of species is warranted here. We found that leaves decomposed at rates different from what we had predicted. Because evergreen sumac and Ashe juniper are evergreen, we predicted that they would decompose slower than red oak. However, evergreen sumac leaves decomposed the fasted (Figure 3), followed by red oak (Figure 4). Ashe juniper leaves decomposed the slowest (Figure 5).

DISCUSSION and FUTURE PLANS

Our initial analysis of plant community structure revealed no differences between 2013 and 2014 among communities. However, our use of growth forms may not be as informative as a more thorough analysis. Ideally, these community data need to be delineated using hierarchical cluster analysis (McCune and Grace 2002) where one looks for differences among communities and years using differences in species rather than growth forms. Once this hierarchical clustering is complete, we will then use an ordination technique such as non-linear multidimentional scaling.

Leaves decomposed at different rates depending on species. Evergreen sumac decomposed the fasted, followed by red oak. Ashe juniper, not surprisingly, decomposed the slowest. Leaf decomposition also decomposed differently depending on site (Figure 3,4,5). This appears to be based on water availability in the soil (e.g. PP07 is the riparian area, with presumably the wettest soils), although more work needs to be done to determine the controls with respect to litter decomposition as this can be very complex (Aerts 1997).

Our immediate plans are to continue to work on the plant community analysis to determine if any detectable differences exist within the dataset with respect to 2013 and 2014. Additionally, future work involves a more in depth study of the decomposition of leaf litter for these species. Assaying for both fungal and microbial growth, as well as more detailed determination of the labile or recalcitrant compounds in these leaves, would give a better understanding of the controls of soil respiration at Wild Basin. Finally, this work could continue in the future to detect the longer term change at Wild Basin

Wilderness Preserve, and to further delineate how year to year variability affects plant community structure.

LITERATURE CITED

Aerts, R. 1997. Climate, leaf litter chemistry and leaf litter decomposition in terrestrial ecosystems: a triangular relationship. Oikos 79:439-449.

BCP Land Management Plan. 2005. Prepared by the committee for Wild Basin Wilderness, Wild Basin Preserve

Callaghan et al. 2011. Multi-decadal changes in tundra environments and ecosystems: The International Polar Year-Back to the Future Project (IPY-BTF). Ambio 40:555-557.

Forest for the trees: a strategic long range plan for the Wild Basin Wilderness Preserve 1999-2004.

Inouye, R. 2002. Sampling efforts and vegetation cover estimates in sagebrush steppe. Western North American Naturalist 62:360-364.

Johnson, D.R. M. Satcher and L. Kelley. 2013. Annual Report: Vegetation survey at Wild Basin Wilderness Preserve and Adjacent BCP Vireo Preserve. Prepared for Balcones Canyon Preserve, Travis County, TX and City of Austin, TX.

McCune, B. and J.B. Grace. 2002. Analysis of ecological communities. MjM Software Design.

Respes, K. 1987. Notes towards a vegetation history of Wild Basin. Unpublished report.

Williams, J.E. 1977. Recommendations concerning the vegetation of Wild Basin. Unpublished report.

FIGURES

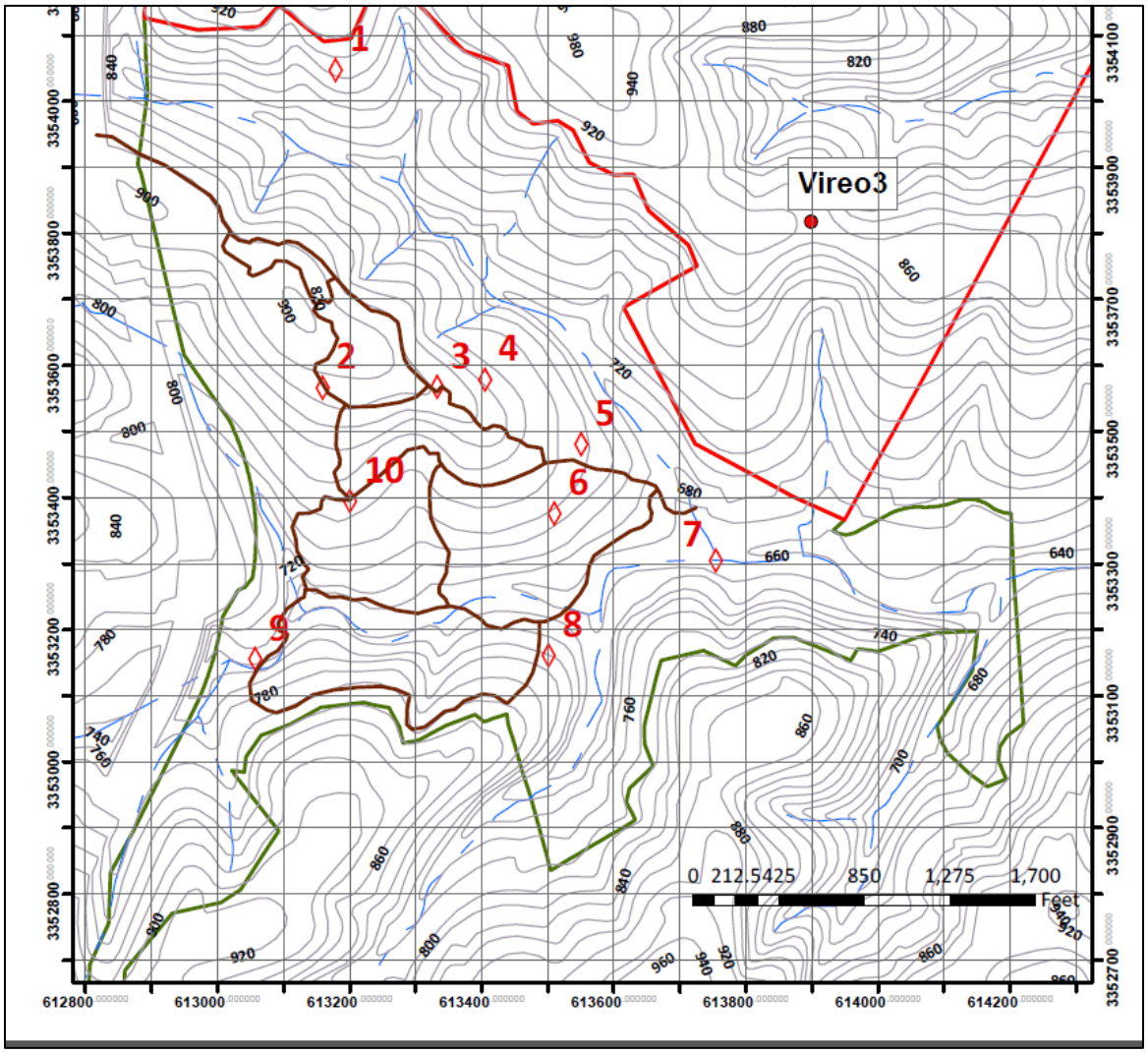


Figure 1. A map of 10 photo points (diamonds) located within Wild Basin Preserve. The point marked Vireo 3 is within the BCP Vireo Preserve, was sampled in 2013, but will not be included in this study.

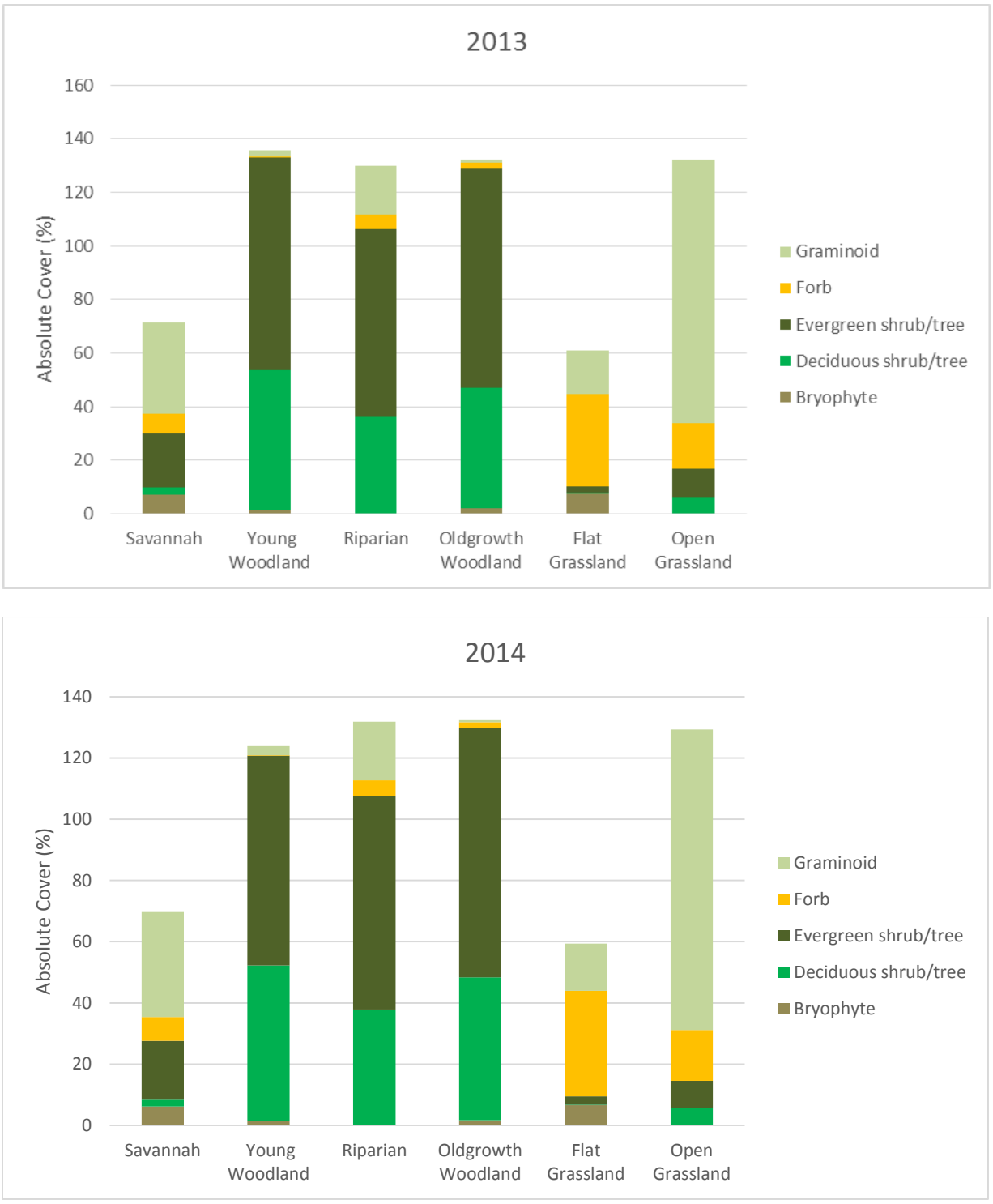


Figure 2. The absolute cover of various growth forms in communities at Wild Basin in 2013 (top panel) and 2014 (bottom panel).

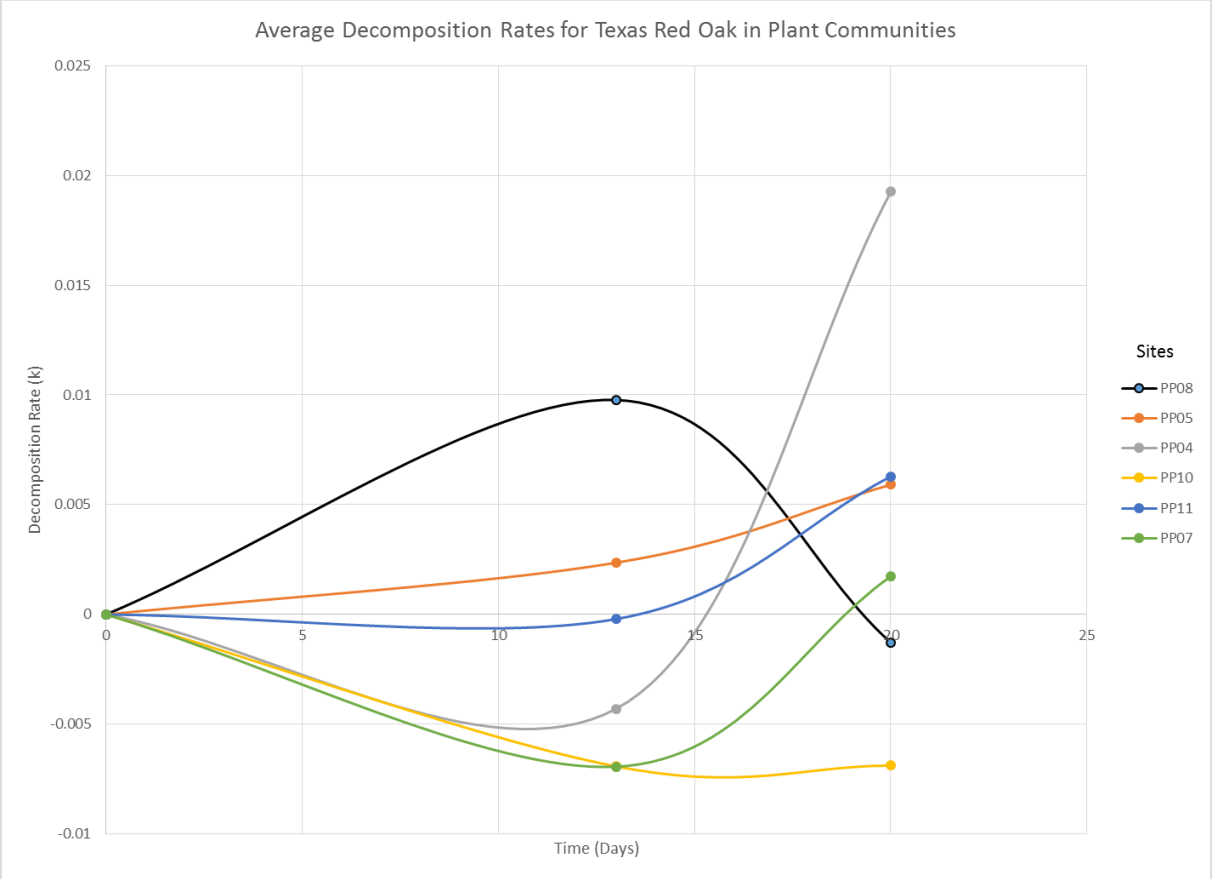


Figure 3. Decomposition rate of Texas red oak leaves from litter bags in various sites at Wild Basin Wilderness Preserve.

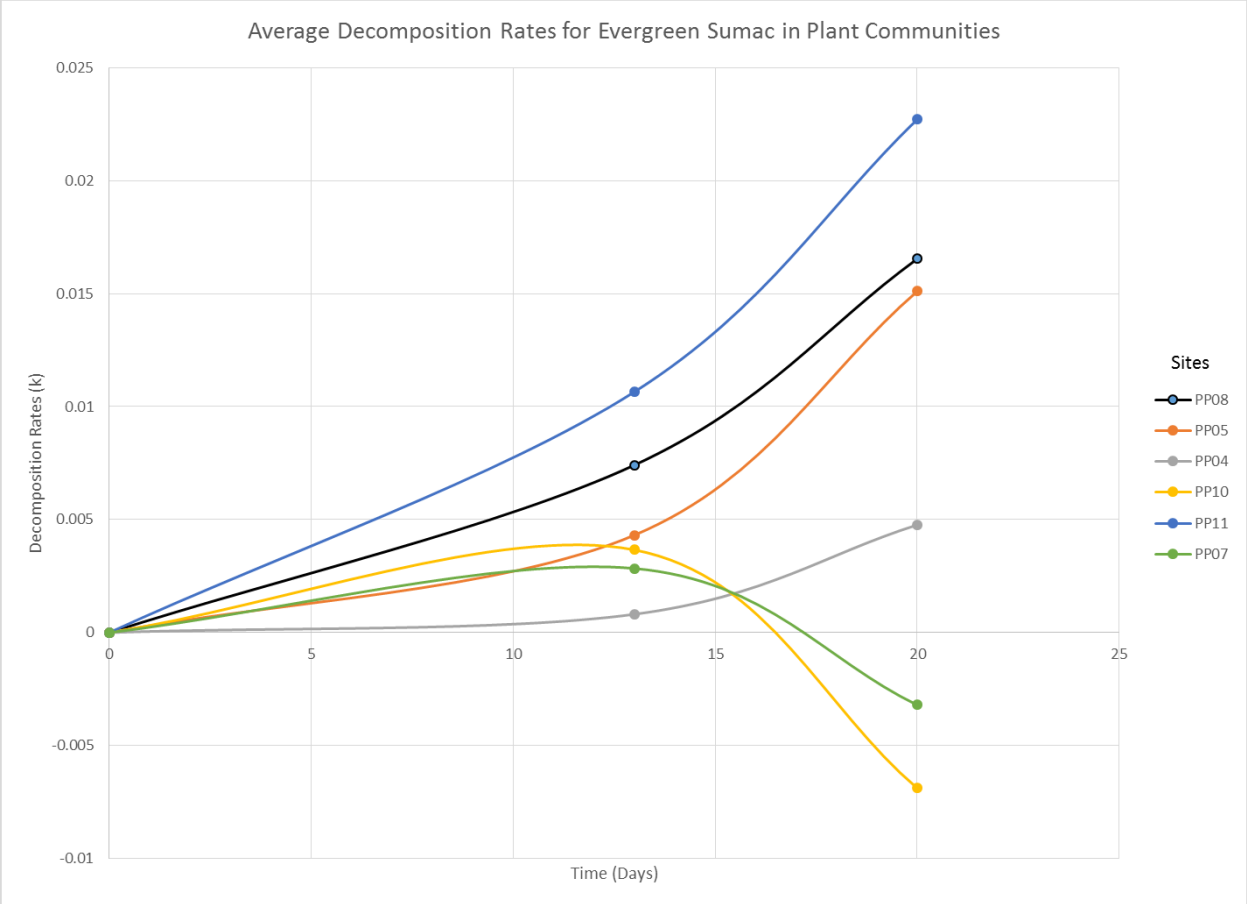


Figure 4. Decomposition rate of evergreen sumac leaves from litter bags in various sites at Wild Basin Wilderness Preserve.

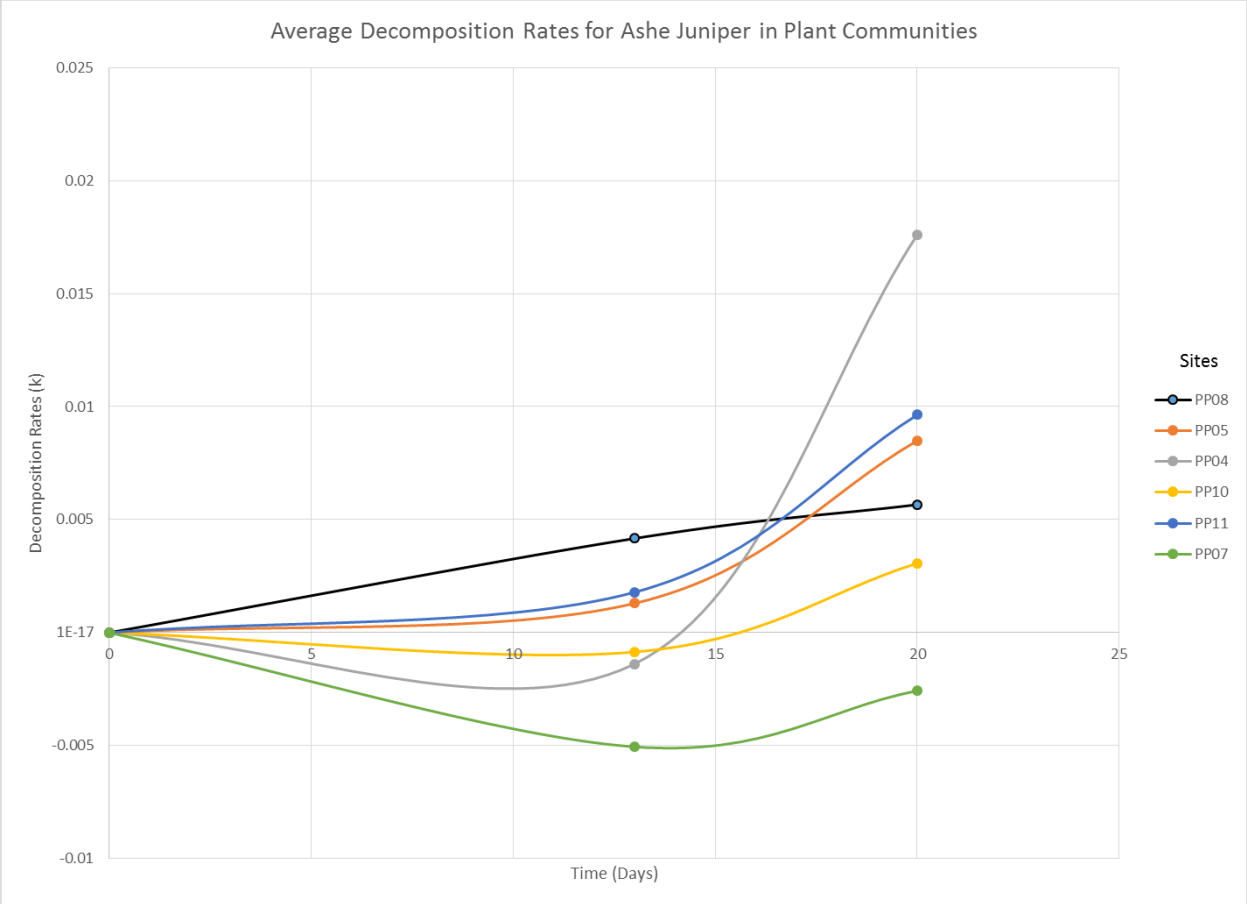


Figure 5. Decomposition rate of Ashe juniper leaves from litter bags in various sites at Wild Basin Wilderness Preserve.